



Federal Communications Commission
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Small Entity Compliance Guide

White Space Devices and Unlicensed Wireless Microphones

Report and Order
FCC 15-99
ET Docket No. 14-165
Released: August 11, 2016

This Guide is prepared in accordance with the requirements of Section 212 of the Small Business Regulatory Enforcement Fairness Act of 1996. It is intended to help small entities—small businesses, small organizations (non-profits), and small governmental jurisdictions—comply with the new rules adopted in the above-referenced FCC rulemaking docket(s). This Guide is not intended to replace the rules and, therefore, final authority rests solely with the rules. Although we have attempted to cover all parts of the rules that might be especially important to small entities, the coverage may not be exhaustive. This Guide may, perhaps, not apply in a particular situation based upon the circumstances, and the FCC retains the discretion to adopt approaches on a case-by-case basis that may differ from this Guide, where appropriate. Any decisions regarding a particular small entity will be based on the statute and regulations.

In any civil or administrative action against a small entity for a violation of rules, the content of the Small Entity Compliance Guide may be considered as evidence of the reasonableness or appropriateness of proposed fines, penalties or damages. Interested parties are free to file comments regarding this Guide and the appropriateness of its application to a particular situation; the FCC will consider whether the recommendations or interpretations in the Guide are appropriate in that situation. The FCC may decide to revise this Guide without public notice to reflect changes in the FCC's approach to implementing a rule, or to clarify or update the text of the Guide. Direct your comments and recommendations, or calls for further assistance, to the FCC's Consumer Center:

1-888-CALL-FCC (1-888-225-5322)
TTY: 1-888-TELL-FCC (1-888-835-5322)
Fax: 1-866-418-0232
<mailto:fccinfo@fcc.gov>

White Space Devices and Unlicensed Wireless Microphones Compliance Requirements

1. Objectives of the Proceeding

In ET Docket 04-186, the FCC adopted rules that allow unlicensed radio transmitters to operate in the broadcast television spectrum at locations where that spectrum is not being used by licensed services. This unused TV spectrum is often termed “white spaces.” The FCC’s actions made a significant amount of spectrum available for new and innovative products and services, including broadband data and other services for businesses and consumers. These actions created opportunities for small businesses to develop new types of communication devices and services. The rules adopted include many safeguards to prevent harmful interference to incumbent communications services.

In the 2014 *Incentive Auction Report and Order* in GN Docket No. 12-268, the Commission decided to repurpose a portion of the UHF TV spectrum for licensed wireless services (the “600 MHz Band”). The Commission’s band plan provides for a guard band between television spectrum and 600 MHz downlink services, a guard band between 600 MHz uplink and downlink services (a duplex gap), and guard bands between 600 MHz downlink services and channel 37.

A copy of the *Report and Order* in GN Docket No. 12-268 is available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-50A1.pdf (29 FCC Rcd 6567 (2014))

The *Report and Order* in this proceeding (ET Docket No. 14-165) made a number of rule changes to provide greater flexibility for white space devices that operate in the remaining TV spectrum and in the 600 MHz service band at locations where a licensee has not yet commenced operations. It will allow white space devices to operate in the 600 MHz guard bands, duplex gap and on channel 37. In addition, the *Report and Order* modified the rules to allow wireless microphones to operate in the guard bands and duplex gap, and codified Part 15 rules for unlicensed wireless microphones.

A copy of the *Report and Order* in ET Docket No. 14-165 is available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-99A1.pdf (30 FCC Rcd 9551 (2015))

Concurrently with the *Report and Order* in this proceeding, the Commission adopted a *Report and Order* in ET Docket No. 14-166 concerning licensed wireless microphones. Please see the *Small Entity Compliance Guide* in that proceeding for a description of the requirements for licensed wireless microphones.

2. General Information

Part 15 of the FCC rules contains the technical requirements for radio frequency (RF) devices that may be operated without an individual license. The requirements include radiated and power line conducted emission limits for intentional and unintentional radiators.

Intentional radiators are devices that intentionally generate and emit RF energy, *i.e.*, transmitters. Examples of Part 15 intentional radiators include cordless telephones, remote control transmitters, remote utility meter readers, and wireless local area networking equipment. Part 15 intentional

radiators must be certified by the FCC or a designated Telecommunication Certification Body (TCB) before they can be imported into or marketed within the United States.

Unintentional radiators are devices that intentionally generate, but do not intentionally emit, RF energy. Examples of Part 15 unintentional radiators include radio receivers, computers and TV interface devices such as DVD players, cable and satellite boxes. Most unintentional radiators can be authorized through a self-approval process in which the manufacturer has the equipment tested to ensure it complies with the Part 15 rules, but does not have to obtain certification through the FCC or a TCB. However, scanning receivers and radar detectors are required to be certified before they can be imported into or marketed within the United States.

3. What is an unlicensed wireless microphone?

An unlicensed wireless microphone is a Part 15 intentional radiator that converts sound into electrical audio signals that are transmitted using radio signals to a receiver which converts the radio signals back into audio signals that are sent through a sound recording or amplifying system. Wireless microphones may be used for cue and control communications and synchronization of TV camera signals as defined in § 74.801, and do not include auditory assistance devices as defined in § 15.3(a).

4. What compliance requirements apply to unlicensed wireless microphones?

- Operation is permitted on the following frequencies
 - Channels allocated and assigned for the broadcast television service
 - Specific portions of the 600 MHz guard bands and duplex gap
 - The 600 MHz service band in areas where a licensee has not commenced operations. Operation in this band must cease no later than the end of the post-auction transition period as defined in § 27.4 of the rules, and must cease immediately if harmful interference occurs to a 600 MHz service licensee
- Prior to operation in the 600 MHz guard bands, duplex gap or service band, wireless microphone users shall rely on the white space databases to determine that their intended operating frequencies are available for unlicensed wireless microphone operation at the location where they will be used. Wireless microphone users must register with and check a white space database to determine available channels prior to beginning operation at a given location, and must re-check the database for available channels if a wireless microphone is moved to another location.
- The maximum radiated power shall not exceed:
 - 50 mW EIRP in the bands allocated and assigned for broadcast television and in the 600 MHz service band
 - 20 mW EIRP in the 600 MHz guard bands and duplex gap
- Operation is limited to locations separated from licensed services by the distances shown in Section 15.236(e) of the rules.
- The operating frequency within a permissible band of operation must comply with the frequency offset and stability requirements of Section 15.236(f).
- Out-of-band emissions must comply with the limits in Section 15.236(g).

5. What is a white space device?

A white space device is a Part 15 intentional radiator that operates on available channels in the broadcast television frequency bands, the 600 MHz band (including the guard bands and duplex gap), and in 608-614 MHz (channel 37). There are two categories of white space devices: fixed and personal/portable.

6. What is a fixed white space device?

A fixed white space device transmits and/or receives radiocommunication signals at a specified fixed location. Fixed white space devices can be used to provide services such as wireless broadband access in urban and rural areas.

7. What is a personal/portable white space device?

A personal/portable white space device transmits and/or receives radiocommunication signals on available channels at unspecified locations that may change. Personal/portable white space devices can take the form of devices such as Wi-Fi-like cards in laptop computers or wireless in-home local area networks.

8. What types of operation are permitted for personal/portable white space devices?

There are three types of operation permitted for personal/portable white space devices. A single device could be capable of more than one type of operation.

- 1) Mode I operation: the white space device operates under the control of a fixed or Mode II white space device that determines the available channels at a particular location.
- 2) Mode II operation: the white space device is capable of determining the available channels at its location using geo-location and database access.
- 3) Sensing-only operation: the white space device uses spectrum sensing and does not rely on geo-location/database access or another device to determine available channels.

9. What are the compliance requirements that apply to all white space devices?

- A white space device must incorporate transmit power control and must limit the operating power to the minimum necessary for successful communication. A description of the transmit power control mechanism must be submitted with the application for certification. For general information about the certification process for white space devices, see Sections 15 and 19 below.
- A white space device must have the capability to display a list of identified available channels and its operating channel.
- A white space device must comply with the RF safety requirements of Section 15.709(h).
- In-band power must comply with the limits in Section 15.709(a) through (c).
- Out-of-band emissions must comply with the limits in Section 15.709(d).
- A white space device must be labeled with an FCC identification number as required by Section 2.925 and the statement required by Section 15.19(a)(3) indicating that the device complies with Part 15 of the rules, may not cause harmful interference and must accept any interference received.

- The instruction manual must contain the statement shown in Section 15.706(a) that advises of the potential for a white space device to cause harmful interference and lists possible measures to correct any interference that does occur.
- White space devices, except for sensing-only devices, must incorporate adequate security measures to ensure that they are capable of communicating for purposes of obtaining lists of available channels only with databases operated by administrators authorized by the Commission, and to ensure that communications between white space devices and databases and between white space devices are secure to prevent corruption or unauthorized interception of data. This requirement includes implementing security for communications between Mode I personal portable white space devices and fixed or Mode II white space devices for purposes of providing lists of available channels. See Sections 15.711(j)(1) through (j)(2).
- Applications for certification of white space devices must include a high level operational description of the technologies and measures that are incorporated in the device to comply with the security requirements. See Section 15.711(j)(4).

10. What are the compliance requirements that apply to fixed white space devices?

- Operation is permitted on the following frequencies
 - The bands allocated and assigned to broadcast television licensees
 - Specific portions of the 600 MHz guard bands and duplex gap
 - The 600 MHz service band in areas where a licensee has not commenced operations
 - 608-614 MHz (channel 37)
- The maximum transmit power to the antenna may not exceed one watt in a 6 MHz channel. Lower power may be required to protect other services within or adjacent to the frequency band of operation.
 - In less congested areas (50% of channels available), if the antenna gain exceeds 10 dBi, the transmit power must be reduced by the amount in dB that the gain exceeds 10 dBi.
 - In all other areas, if the antenna gain exceeds 6 dBi, the transmit power must be reduced by the amount in dB that the gain exceeds 6 dBi.
- The transmit antenna may not be more than 30 meters above ground.
- The transmit antenna height above average terrain (HAAT) may not exceed 250 meters.
- The white space device must incorporate a geo-location capability to determine its location and geo-location uncertainty with a confidence level of 95%. Alternatively, the device may be professionally installed by a party that determines the device's geographic coordinates and programs them into the device.
- The white space device must be capable of accessing a database over the internet that provides a list of available channels at its location, taking into account the geo-location uncertainty determined by the device.
 - It must submit the registration information listed in Section 15.713(g)(3) when it initially accesses the database or after changing location.
 - It may operate only on channels that the database indicates are available, and at a power level no greater than the database indicates can be used with each available channel.
 - It must access the database at least once a day to verify that the operating channel continues to remain available, and operation on a channel must cease if it is no longer available.
 - It must be able to adjust its channel use in accordance with channel availability scheduling information provided by the database.

- It must comply with the push notification requirements of Section 15.711(i).
- If the database cannot be contacted during any given day, the white space device may continue to operate until 11:59 PM on the following day at which time it must cease operation if it still has not contacted the database.
- The white space device must transmit identification information that conforms to a recognized industry standard and contains sufficient information to identify the device and its geographic coordinates.

11. What are the compliance requirements that apply to personal/portable white space devices?

- Operation is permitted on the following frequencies:
 - The bands allocated and assigned to broadcast television licensees, excluding channels 2-13
 - Specific portions of the 600 MHz guard bands and duplex gap
 - The 600 MHz service band in areas where a licensee has not commenced operations
 - 608-614 MHz (channel 37)
- The maximum transmit power may not exceed 100 milliwatts EIRP in a 6 MHz channel, except:
 - 40 milliwatts EIRP for white space devices that do not comply with separation distances from adjacent channel TV stations, or in the 600 MHz guard bands and duplex gap
 - 50 milliwatts EIRP for sensing-only white space devices.
- The transmit antenna must be permanently attached.

12. What are the compliance requirements specific to Mode I personal/portable white space devices?

- The white space device may only transmit upon receiving transmissions from a fixed or Mode II device that has contacted a database and verified that the FCC identifier (FCC ID) of the Mode I device is valid.
- It may transmit on either an operating channel of the fixed or Mode II device or on a channel that the fixed or Mode II device indicates is available for use.
- At least once every 60 seconds, except when in sleep mode, it must either receive a contact verification signal from the Mode II or fixed device that provided its current list of available channels or contact a Mode II or fixed device to re-verify/re-establish channel availability.

13. What are the compliance requirements specific to Mode II personal/portable white space devices?

- The white space device must incorporate a geo-location capability to determine its location and geo-location uncertainty with a confidence level of 95%. It must re-establish its position each time it is activated from a power-off condition and use its geo-location capability to check its location at least once every 60 seconds while in operation, except while in sleep mode.
- The device must be capable accessing a database over the internet that provides a list of available channels at its location.
 - The device must provide its FCC identifier, manufacturer's serial number and geographic coordinates to the database.

- Operation is permitted only on channels that are indicated in the database as being available for white space devices.
- The device must access the database for a list of available channels each time it is activated from a power-off condition and re-check its location and the database for available channels if it changes location more than 100 meters during operation.
- It must be able to adjust its channel use in accordance with channel availability scheduling information provided by the database.
- A white space device that has been in a powered state shall re-check its location and access the database daily to verify that the operating channel(s) continue to be available.
- If the database cannot be contacted during any given day, the device may continue to operate until 11:59 PM on the following day at which time it must cease operation if it still has not contacted the database.
- It must comply with the push notification requirements of Section 15.711(i).
- The device may load channel availability information for multiple locations around its current location and use that information to define a geographic area within which it can operate. A device using such channel availability information for multiple locations must contact the database again if/when it moves beyond the boundary of the area where the channel availability data is valid, and must access the database daily even if it has not moved beyond that range to verify that the operating channel(s) continue to be available.

14. What is the white space database?

The white space database is a privately owned and operated service that fixed and Mode II devices must contact to obtain information on channel availability at the locations where they are operated and, in the case of fixed devices, to register their operation at those locations. The FCC has designated multiple database administrators from the private sector to create and operate the white space databases. A list of database administrators is available on the Commission's web site at <https://www.fcc.gov/general/white-space-database-administrators-guide>. Database administrators may charge fees for the provision of lists of available channels to white space devices and for the registration of fixed devices and temporary broadcast auxiliary links. A white space database is required to contain information including:

- Records for stations in all of the authorized services that operate in the TV bands using fixed transmitters with designated service areas, including full service and low power TV stations.
- The service paths of broadcast auxiliary point-to-point facilities.
- The geographic regions served by private land mobile and commercial mobile radio service operations on channels 14-20.
- Regions served by the Offshore Radiotelephone Service.
- The locations of cable headends and low power TV receive sites that are outside the protected contours of the TV stations whose signals they receive.
- The locations of registered sites where wireless microphones and other low power auxiliary devices are used on a regular or scheduled basis.
- Registration information for fixed white space devices.
- Areas where 600 MHz band licensees have commenced operation.
- Locations of health care facilities that use the WMTS systems on channel 37.

15. What are the certification approval requirements for wireless microphones and white space devices?

All wireless microphones and white space devices must be certified by a Telecommunications Certification Body (TCB) before they can be imported into or marketed within the United States. Sensing-only white space devices have additional approval requirements that are listed below in Section 16. Please refer to 47 CFR § 15.236 for detailed information on the unlicensed wireless microphone approval requirements, 47 CFR § 15.701, *et. seq.* for detailed information on the white space device approval requirements and 47 CFR § 2.901, *et. seq.* for information on the equipment certification procedures. See also information about certification contained in Section 19 of this Guide, *infra*.

16. What are the certification approval requirements for sensing-only white space devices?

- Sensing-only white space devices must demonstrate with an extremely high degree of confidence that they will not cause harmful interference to incumbent radio services.
- The device must meet the requirements for personal/portable devices except that it will be limited to a maximum EIRP of 50 milliwatts and does not have to comply with the requirements for geo-location and database access.
- The device must comply with spectrum sensing requirements.
 - Be capable of detecting the following signal types at the specified levels.
 - Digital TV signals: -114 dBm, averaged over a 6 MHz bandwidth
 - Analog TV signals: -114 dBm, averaged over a 100 kHz bandwidth
 - Wireless microphone signals: -107 dBm, averaged over a 200 KHz bandwidth
 - Compliance with these thresholds is required, but not necessarily sufficient, for demonstrating reliable interference avoidance. In addition, the device must pass laboratory and field tests conducted by the Commission as set forth below.
 - The detection thresholds are referenced to an omnidirectional receive antenna with a gain of 0 dBi.
 - If a receive antenna with a minimum directional gain of less than 0 dBi is used, the detection threshold must be reduced by the amount in dB that the minimum directional gain of the antenna is less than 0 dBi.
 - Alternative approaches for a sensing antenna are permitted, such as electronically rotatable antennas, provided the applicant for equipment authorization can demonstrate that they provide at least the same performance as an omnidirectional antenna with a gain of 0 dBi.
 - A device may begin operating on a TV channel if no TV, wireless microphone or other low power auxiliary device signals are detected within a minimum time interval of 30 seconds.
 - A white space device must provide in-service monitoring of an operating channel at a minimum of once every 60 seconds.
 - After a TV, wireless microphone or other low power auxiliary device signal is detected on an operating channel, all transmissions on that channel must cease within two seconds.
- Once a device is certified, additional devices that are identical in electrical characteristics and antenna systems may be certified under the standard equipment authorization procedures.
- The following equipment authorization requirements apply in addition to the requirements in Part 2 of the rules:

- The application must include a full explanation of how the device will protect incumbent authorized services against interference.
- A pre-production device, identical to the device expected to be marketed, must be submitted to the FCC for testing.
- Applications for sensing-only white space devices will be processed as follows:
 - Applications will be placed on Public Notice for a minimum of 30 days for comments and 15 days for reply comments. The Public Notice will include proposed test procedures and methodologies.
 - The Commission will conduct laboratory and field tests of the pre-production device which will be open to the public. This testing will be conducted to evaluate proof of performance of the device, including characterization of its sensing capability and its interference potential.
 - After the completion of testing, the Commission will issue by Public Notice, a test report including recommendations. The Public Notice will provide at least 30 days for comments and, if any objections are received, an additional 15 days for reply comments.
 - The decision on whether to certify a white space device that relies on spectrum sensing will be made by the full Commission.

17. What are the penalties for non-compliance with the rules?

- Willful or repeated violations of the equipment authorization, importation and marketing rules can result in forfeitures of up to \$16,000 for each violation or each day of continuing violation, up to a maximum of \$122,500. See Section 1.80 of the FCC rules. Individuals or organizations may also be subject to criminal penalties under Title 18 of the U.S. Code. FCC field personnel, working in conjunction with the Attorney General of the United States, may seize illegal equipment. See 47 U.S.C. § 510(b).
- Under Section 15.715(k) of the rules, the FCC can require database administrators to make no channels available to models of white space devices that it determines are non-compliant with the rules, thus preventing such devices from transmitting. Devices that are non-compliant with FCC rules are considered to be illegal equipment.

18. What if I have questions on the wireless microphone or white space device rules?

The FCC maintains a web-based system that is used to submit inquiries to its Laboratory, as well as to search for previous rule interpretations and frequently asked questions. This system, called the OET Knowledge DataBase (KDB), can be accessed at www.fcc.gov/labhelp.

19. Where can I find the wireless microphone and white space device rules and information on the certification procedure?

The FCC Rules are available at:

http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title47/47tab_02.tpl

Equipment authorization information:

<http://www.fcc.gov/oet/ea/>